

How Much Radiation is There?

Determining what is there through characterization

Historical data exists from investigations that were conducted in 1978 and 1985, and from targeted characterizations that NASA has conducted over the last several years in preparation for decommissioning.

A thorough, formal, detailed radiological survey is being conducted on every material such as concrete, soil and any residual water inside the Reactor Facility and on the grounds of the entire 27-acre site.

Characterization is an iterative process that will continue throughout decommissioning to provide NASA with a radiological baseline for every source of radioactivity at the site from:

FIXED CONTAMINATION
(embedded in the material)

LOOSE CONTAMINATION
(like surface dust)

ACTIVATION
When a material, such as the metal or concrete located close to the reactor core, is exposed to a high enough radiation level, the original material has changed into something that is itself radioactive.

ANY COMBINATION

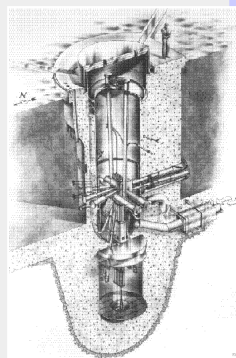
Conducting the Characterization

Health physics professionals have divided the entire site into discrete areas for inspection. They have calculated the number, types and depths of sampling for each area. If preliminary testing detects "hot spots" of radioactivity, further investigation will take place. Testing methods include:

Reactor Internals Investigation

Entering the reactor tank after nearly 30 years provides critical information for planning the disassembly or segmentation and removal of the tank and its internals. Using remote tools and cameras, workers can:

- ▶ Confirm expected inventory and how components are arranged inside the tank.
- ▶ Determine current physical condition/corrosion that may affect how the reactor is taken apart.
- ▶ Take direct radiation readings, loose contamination swipes, and snip an end of aluminum tubing (physical sample) for analysis at a certified offsite laboratory.



Cross section of reactor internals

Direct radiation

Hand-held detection devices, referred to as "friskers" are passed over a particular area. They are used to read the radiation field that is the combined results of any fixed and loose contamination.

Physical samples are collected and analyzed onsite or sent to a certified offsite lab for analysis. Samples include:

Smears (swipes with a dampened cloth)

Bulk sampling (soil samples, concrete borings)

Results Guide Next Steps

Characterization Results

The information gathered is vital to planning the next steps of decommissioning. Results serve to:

Identify types and amounts of isotopes present, including the mix of isotope types in each area	Identify hazards in each area and develop work procedures and personal protective equipment	Develop decontamination planning (determine best methods for cleaning a surface based on how deeply contamination has penetrated)	Properly package waste for shipping	Route waste to Low Level Radioactive Waste (LLRW) disposal facilities that can accept specific types and quantities	Support final status survey planning to meet cleanup criteria and terminate license
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Activation Analysis

A computer-generated Activation Analysis looks at the metals that make up the reactor vessel components, and based on how irradiated they got, tells what the expected composition of the material and what the resulting radiation levels would be today. Modeling this information tends to overestimate, or predict higher amounts of radioactivity than may actually be present. Results of this analysis along with limited physical sampling are used to “anchor” the characterization.

Data used in this modeling includes:

- ▶ Exact inventory of material inside the core
 - ▶ The material's proximity to the core
 - ▶ The power history of the reactor - flux profile
 - ▶ Time since shutdown (to allow natural decay)
- Flux Profile is the density of neutrons that were given off by the reactor during operation, or how much power was used and for how long.

Half-life
Radioactive atoms undergo decay as an atom spontaneously gives off its extra energy. The rate of decay varies and is measured in a half-life - the time it takes for half the number of identical radioactive atoms to decay to another form.

Activation Analysis Results

Current findings are consistent with results from past investigations. Results show that the level of radioactivity at the site has decreased (as predicted) since shutdown and removal of all fuel nearly 30 years ago because short half-life isotopes have already significantly decayed. The remaining sources are primarily in the form of tritium (H-3), with much lesser amounts of cobalt (Co60). These are long-lived isotopes so future decay will not result in the same large reductions seen early on.

The Activation Analysis shows that material is all expected to be Low Level Radioactive Waste (LLRW), mostly Class A - the least amount of radioactivity, much less Class B Waste, and even smaller amounts of Class C. Current calculations suggest the potential presence of a very small amount (enough to fill a 5-gallon bucket) of material may be classified as “Greater than Class C” LLRW. This limited quantity is in dozens of small stainless steel (containing nickel) components such as nuts and bolts, located next to the reactor core. Though classification cannot be confirmed until those components are taken out during segmentation, NASA is using the estimates now in planning for safe handling and all disposal options.